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THE INFLUENCE OF SENSOR TO SHOOTER TECHNOLOGY ON THEATER LEVEL DECISION MAKING

by

William J. Powell
LTCOL USMC

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the JMO Department.

The contents of this paper reflect my own personal and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: William J. Powell

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Col. Larry A. Wood
L A Wood
Faculty Advisor

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15. Abstract: Accelerating changes in technology suggest that the current paradigm used for military decision making be closely examined to determine if a more suitable process should be used in the future. The current model is described, the changing technologies that directly affect it are reviewed, followed by a discussion of the decision making process. Finally a new schema for decision making is proposed along with its rational and possible implications.

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THE INFLUENCE OF SENSOR TO SHOOTER TECHNOLOGY ON THEATER LEVEL DECISION MAKING

> "To date, the bulk of the intellectual and physical development associated with the current Revolution in Military Affairs has focused on new systems and technologies. What is needed now is a careful analysis of the new operational concepts. . . ."[1]

Today, no potential adversary can match the battlefield potency of the joint military forces of the United States. However, enlightened American war-fighters have valid concerns for the future because warfare in the 21st century will be dramatically different. Overshadowing future battlefields is a technological revolution, based upon superiority in information systems, sensors and weapons, that will impact all aspects of modern warfare. **Tomorrow's combat will require streamlining today's commonly used decision making paradigm known as the Observe, Orient, Decide, Act (OODA) Loop to a more concise cycle to ensure a Joint Force Commander can take full advantage of the Military Technological Revolution.**

The Status Quo

The accelerating changes in technology require that serious thought be given to modification of the present decision paradigm-- the Boyd Model. The Boyd Model, commonly called the OODA Loop, is the currently accepted decision making model used within the U.S. military community. It is the product of retired Air Force Colonel John Boyd who pioneered the concept in his lecture, "The Patterns of Conflict." Boyd

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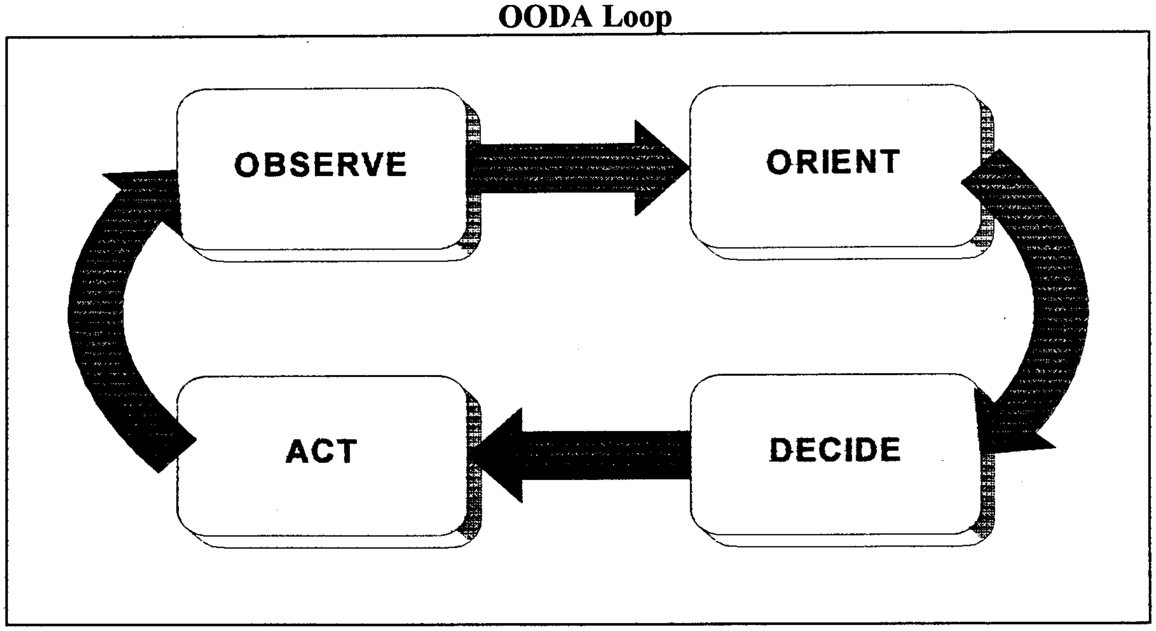
[1]. Barry R. Schneider and Lawrence E. Grinter, Battlefield of the Future, Air War College Studies in National Security No. 3 (Maxwell Air Force Base, Alabama: Air University Press, September 1995), 66.

identified a four-step mental process: observation, orientation, decision and action. Boyd theorized that each party to a conflict first observes the situation. On the basis of the observation, he orients; that is, he makes an estimate of the situation. On the basis of the orientation, he makes a decision. Finally, he acts upon the decision.[2] Because his action has created a new situation, the process begins anew as illustrated in the model in figure 1 below.

Figure 1
OODA Loop



What Combat Requires

Successful combat requires three basic actions: finding targets, processing information about targets, and striking targets (while avoiding the same fate).[3] The sniper, fighter pilot, submarine commander and Commander in Chief (CINC), among others, all

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2. Department of the Navy, Warfighting, FMFM 1, (Washington), 84.

3. Martin C. Libicki, The Mesh And The Net: Speculations On Armed Conflict In A Time Of Free Silicon. McNair Paper 28, (Washington: National Defense University, 1994), 24.

need to find and neutralize targets to accomplish the mission. To better understand how emerging sensor to shooter technology links will necessitate faster, operational decision making, consider the following basic functions of combat and the continuous cycle as illustrated in figure 2:

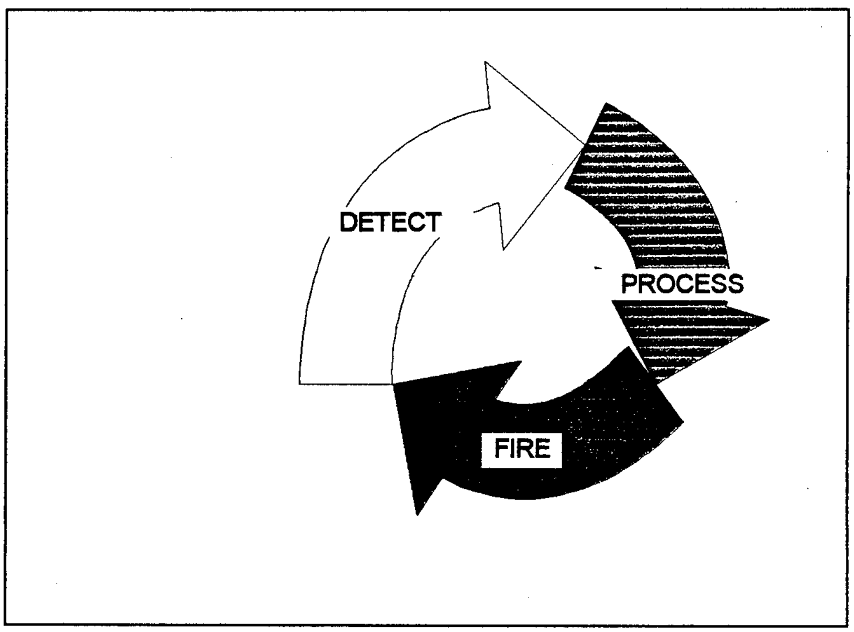
* Detect--to obtain information about threats.

* Process--to manage information for decision making and implementation.

* Fire--to implement the decision and neutralize the threat.[4]

Figure 2

Detect Process Fire Cycle



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[4]. Colonel Jose Carlos Albano do Amarante, Brazilian Army, "The Automated Battle: A Feasible Dream?" MILITARY REVIEW, May 1994, 58.

What is Changing?

These basic functions have been impacted most by quantum leaps in development of the three key technologies that impact the Boyd Model directly: Sensors, C4I-Space (C4I-S) and Precision Force. Indeed, advances in these areas require serious consideration be given to improving the method we use to make battlespace decisions.

Sensors

Future sensors will empower commanders with real time, all weather, continuous surveillance in and over large geographical areas. Millions of cheap, yet highly efficient, sensors and extremely capable emitters could be positioned throughout the battlespace at relatively low cost. Carefully tailored, advanced sensor packages used across the entire spectrum of battlespace will provide U.S. Joint Forces enormous intelligence advantages. These sensors will probably include optical, chemical, radar, infrared, pressure, magnetic, sound, vibration, and near ultraviolet capabilities.[5] Such minute devices could be camouflaged as twigs and pebbles and delivered by surface fires or aircraft.

Coupling these new land sensors with improved space and sea-based platforms and stealthy, high altitude, large-payload, unmanned aerial reconnaissance vehicles would give the Joint Force Commander the capability to locate accurately anything worth attacking. Potential targets would also be tracked by small teams on the ground working as human sensors, a concept pioneered by U.S. Special Operations Forces and being explored by the U.S. Marine Corps. The U.S. Army is working on a similar project as part of its Force

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5. Martin C. Libicki, The Mesh And The Net: Speculations On Armed Conflict In A Time Of Free Silicon. McNair Paper 28, (Washington: National Defense University, 1994), 29.

Twenty-one initiative. According to Dr. Jim Blaker, Special Advisor to the Vice Chairman, Joint Chiefs of Staff, "By 2005 we could have a capacity of sensing roughly 90% of everything of interest within 200 square miles."[6]

C4I-Space

Prominent among the new C4I technologies are those that will create a command and coordination "info-sphere." Leading C4I developments include digitization, band-width expansion, direct broadcasting, and critical computer processing power. By the year 2000, a trillion calculations per second will be the norm for the best Department of Defense computers.[7] Such power will handle quickly the data generated by the expansion of sensors, sort out the relevant data, aid the decision making process, and, finally, ensure the appropriate kill mechanisms are assigned to the correct targets.

The capabilities inherent in new C4I-S systems will provide our CINCs with the world's first Dominant Battlespace Knowledge capability. Admiral Owens, the former Vice Chairman of the Joint Chiefs of Staff, calls this the "Knowledge Advantage."[8] This real time information will help the CINC mesh information effectively at the strategic, operational, and tactical levels of war and allow his staff to translate traditional principles

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6. Jim Blaker, "Briefing to Assistant Commandant of the Marine Corps and others," (on Vision Force .April 1995 Version) , Headquarters U.S. Marine Corps: 10 April, 1995.

7. John D Morrocco, "U.S. Military Eyes Revolutionary Change," Aviation Week & Space Technology, May 1, 1995, 23.

8. Admiral William A. Owens, "America's Information Edge," Foriegn Affairs, March/April 1996, 20.

of war and operational art considerations directly into planning calculations. Dominant Battlespace Knowledge will help provide the winning edge for future CINCs.[9]

Precision Force

Tomorrow's brilliant weapons will be refined versions of today's precision guided munitions. Sensor fused weapons will be able to destroy large units with single pass accuracy. Very smart munitions have speeds matching the new C4I environment enabling the commander to achieve synchronization. Strike tools properly employed will minimize civilian casualties and reduce the risk of fratricide. Superior penetration capability, increased accuracy, and greater range of munitions mean reduced risk to friendly personnel and costly platforms. Most importantly, brilliant munitions mean a better chance of success with target sets from the tactical to the strategic levels. However, the foremost benefit will be the resultant operational fires that shape the battlespace.

> "The potential effect of a precision strike can be seen in the dramatic increase of capabilities to strike strategic targets. In 1943 the U.S. Eighth Air Force prosecuted only 50 strategic targets during the course of the entire year. In the first 24 hours of Desert Storm, the combined air forces prosecuted 150 strategic targets, a thousand fold increase over 1943 capabilities. By the year 2020, it is not out of the realm of possibility that as many as 500 strategically important targets could be struck in the first minute of the campaign, representing a five thousand-fold increase over Desert Storm capabilities."[10]

Another form of precision woven into the C4I-S cloth is offensive Information Warfare. Information Warfare is waged to obscure an opponent's surveillance and reconnaissance capability while maximizing one's own clarity and accuracy of the

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9. Jim Blaker, "Briefing to Assistant Commandant of the Marine Corps and others," (on Vision Force.April 1995 Version) , Headquarters U.S. Marine Corps: 10 April, 1995.

10. Barry R. Schneider and Lawrence E. Grinter, Battlefield of the Future, Air War College Studies in National Security No. 3 (Maxwell Air Force Base, Alabama: Air University Press, September 1995), 78.

battlefield. In the Gulf War the coalition's ability to blind Iraqi operational surveillance and reconnaissance capability was key in keeping U.S. casualties low. The claim by many analysts that General Schwarzkopf operated with the best information of any commander in modern times while the Iraqi generals were operating blindly is not an exaggeration.[11] However, to paraphrase an old cliché, 'the General has not seen anything yet.'

Advancing Technologies Affecting the Boyd Model

The new military technological trends point distinctly at a theater-level, integrated sensor to shooter capability cementing all the components of the joint forces, achieving synergistic capabilities similar to those espoused in the science fiction classic Starship Troopers written by Robert A. Heinlein. One of Starship Troopers underlying themes was that a small technologically integrated force could overpower a much larger force.

Integration of capabilities is already a bedrock of current U.S. military dominance, and indications are that the U.S. technological lead will continue to increase in the future. Heinlein's work, written in the early 1950's, demonstrates clearly that the full promise of technological acceleration will be the complete and seamless synchronization of every sensor, shooter, communicator and commander on the battlefield into a single entity responding to the will of the CINC.

> "Tempo is the rate of speed of military action; controlling or altering that rate is essential for maintaining the initiative. . . Commanders seek a tempo that maintains relentless pressure on the enemy to prevent him from recovering from the shock and effects of the attack."[12]

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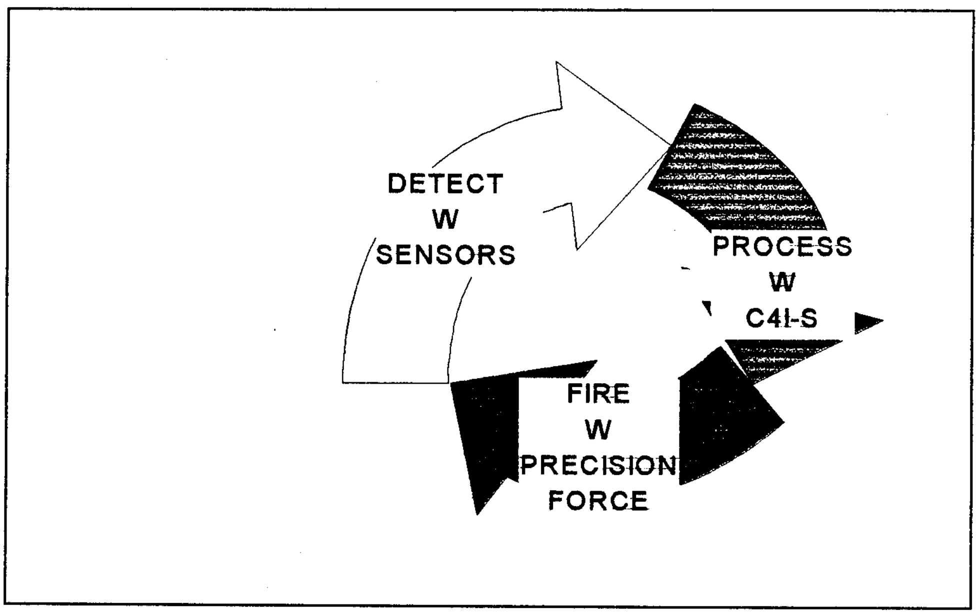
11. Wim A. Smit and others, Military Technological Innovation and Stability in a Changing World (Amsterdam: VU University Press, 1992), 255.

12. Department of the Army, Operations, FM 100-5, (Washington: 14 June 1993), p. 7-3.

Operational tempo depends to a large extent on the speed of the decision making process.[13] Inherently, the natural evolution of battlefield technologies offers us a blueprint for decision making that will enable the CINC to get inside the enemy decision cycle rapidly--a warfighting technique as important as flying the airplane, steering the ship or aiming the weapon. Emerging technologies accentuate the advantage of speed. Tomorrow's requirement is a decision process that enhances the accelerating rate of the basic functions of combat: detect, process, fire as illustrated in figure 3.

Figure 3

Tomorrow's DPF Cycle



[13]. Randall G. Bowdish, "A Theater-Level Sensor-To-Shooter Capability And Its Operational Implications," Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1995, 10.

Paradigms and Schema's

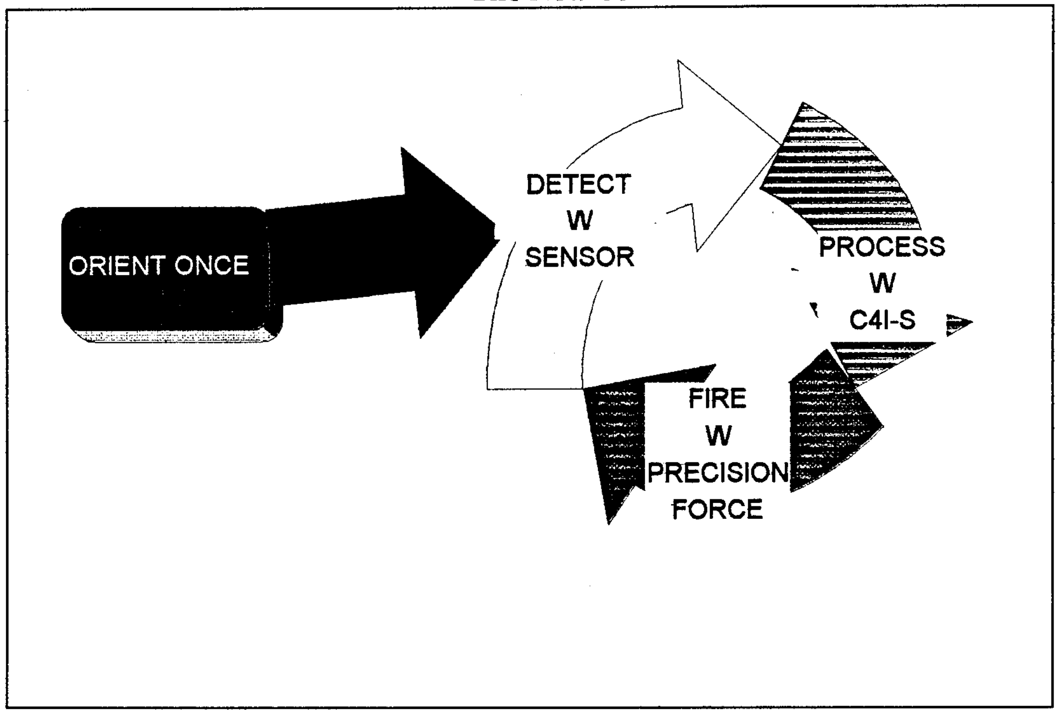
A paradigm is a proven and overall model accepted because of its effectiveness which most people in an intellectual community use to explain a complex process, idea, or set of data. Conversely, a schema is an outline, diagram, plan, or preliminary draft.

The New Schema and Why It Is Needed

If the United States is to compensate for decreased defense funding, while trying to maintain its military hegemony in the face of the worldwide spread of state of the art weapon systems, it must emphasize not only the correct technologies, but also the best possible decision making process. There should be a recognition that the character and the speed of conflict have changed dramatically, requiring adjustments in military doctrine. One cheap and effective approach is focusing on shortening our decision cycle.

Put in a simpler context a common phrase that fighter pilots use is "speed is life." Modern operational commanders must think in terms of speed in their decision making cycle, keeping in mind both human lives and the lifespan of the operation or campaign. Operational decision making will revolve more than ever around the rapid processing of data and information of one's opponent, then dictating action to attack directly or indirectly the enemy's operational center of gravity. A proposed schema for a mid- to high-intensity major regional conflict is illustrated in figure 4.

Figure 4
The New Schema



The critical difference between the Boyd Loop and the schema is orientation. Orientation in this case is not a bearing or grid but the deletion of the orient aspect of the OODA Loop from the Schema. The idea behind the new schema is to orient the battlespace only once. Orientation is normally accomplished through the Commander's Estimate of the Situation. Battlespace is a joint concept that essentially defines the three-dimensional area--width, depth and space--that must be scouted, analyzed, and dominated by U.S. forces in time of war.

> "Analytical decision making is a rational, calculating activity--it is essentially scientific. Intuitive decision making is an arational (but not irrational), sensing activity--it is essentially artistic."[14]

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[14]. Maj John F. Schmitt, USMCR, "How We Decide," Marine Corps Gazette, October 1995, 19.

The Commander's Estimate of the Situation (CES) is unquestionably the best way we know to conduct deliberate planning. The CES is firmly established upon the ideal of analytical decision making which is a derivative multiattribute utility analysis.[15] This requires options to be generated methodically, and then evaluated against weighted criteria. While only the most complex, high cost resource decisions without time constraints use multiattribute utility analysis in its precise form, the CES is closely related in its intent.

Another variant of the analytical method also used in the CES is the examination of the branching trees of responses and counter-responses and the calculation of the outcome. This is a structured process and is relevant until the battle is joined.

After initial contact, technological advances have made reorientation irrelevant, because it simply takes too long. Technology should allow the U.S. to defeat the opponent by depriving him of time before he can bring forces and material to bear to rescue the situation. Once the first rounds go down range, critical time is wasted trying to reorient repeatedly.

After completion of the one time orientation the new schema directs the exploration of the battlespace. This exploration samples critical aspects of the battlespace and modifies the decision maker's perception which in turn leads to continually updated situational awareness. Situational awareness should be the primary basis on which future operational decisions are rendered because of the CINC's decision making experience.

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[15]. Gary A. Kline, "Strategies of Decision Making," Military Review, May 1989, 56.

Recognitional Decision Making theory holds that proficient decision makers are able to use their experience to recognize a situation as familiar, which gives them a sense of what goals are feasible, what queues are important, what to expect next and what actions are typical in that situation.[16] Since intuitive decision making is a skill acquired with practice, an experienced decision maker will rapidly deduce plausible options. A CINC when confronted with a sudden or unexpected change in battlespace conditions will not require a painstaking analysis of tabulating advantages and disadvantages of staff prepared options. In other words, attempts to maintain or increase the tempo by the modern technological theater commander make continuous reorientation a hindrance.

The Recognitional Decision Making Model has at its core a strategy known as satisficing,[17] a process most leaders use every day, especially when making time constrained decisions. Satisficing tends to seize upon the first solution that solves the problem, without a thorough examination of all the possibilities.[18] However, this should not pose a problem for the most experienced decision maker in the command. Normally the CINC will generate only those courses of action that are plausible and pertinent to his vision. Thus satisficing is tailored for the operational art of war that, like all artistry, relies heavily on interpretation and intuition to provide the conceptualization necessary for mastery. Satisficing will rarely produce optimal solutions; it can, however, when used by the true artist, produce excellent solutions rapidly that work especially well under time constraints.

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[16]. Ibid. 58.

[17]. Ibid. 59

[18]. Ibid. 60.

Hypothesis

General George S. Patton was fond of saying, "A good plan violently executed now, is better than a perfect plan next week." I am not suggesting those commanders in contact with the enemy plan on conducting formal CESs. I am suggesting that our service schools teach speed as the most critical factor in future conflict. The new schema allows us to maintain an operational tempo that will optimize our newly developed capabilities. Again, technology is the key here. If the United States has near perfect knowledge, perfectly accurate weapons and a perfect link between the two, a CINC can win so fast he will not have to reorient repeatedly. Naturally there may be instances when a CINC may not want to fire for either military or political reasons but, again, that will generally not require reorientation.

> "The theater commander and staff will have at their disposal computer resources sophisticated enough to handle the tremendous amount of information needed in planning a campaign, but also capable of generating optimum solution recommendations, which can be transmitted instantaneously to the battleforce at the push of a button."[19]

The Detect, Process, Fire cycle is continuous once orientation of the battlespace is complete and the operation commences. Once inside the enemy OODA Loop, the new technologies will permit the Detect, Process, Fire cycle to operate with limited risk to friendly forces or interruption for the entire operation or, at a minimum, throughout an operational phase. Phasing for the most part will become almost seamless and the need for operational pauses will be greatly reduced as the schema virtually destroys the opponent's decision process as illustrated in figure 5.

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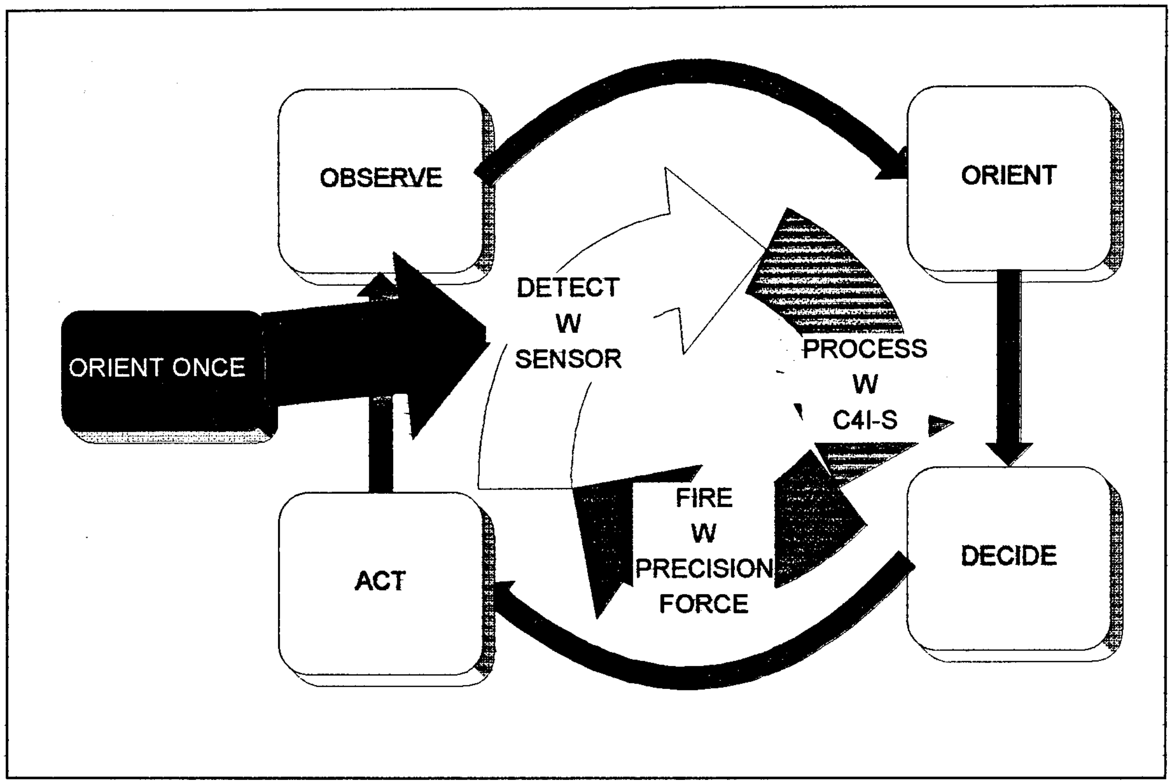
[19]. Randall G. Bowdish, "A Theater-Level Sensor-To-Shooter Capability And Its Operational Implications," Unpublished Research Paper, U.S. Naval War College, Newport, RI: 1995, 2.

Figure 5
Inside The Enemy OODA Loop[20]



As in all wars the commander remains the most critical actor, but he is not the only key player. While the CINC has been freed more than ever to maintain his overwatch position, the staff sustains the operational tempo by maintaining tight discipline on synchronization, operational fires and command and control. Synchronization of these and other principal staff functions would improve unity of effort. The staff would be charged with taking appropriate actions to maintain the overall tempo while ensuring the CINC has the information he requires for his insight.

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[20]. Carol Schmidt, "A picture is still worth a thousand words," when told the paper needed 250 words, Naval War College, 9 May 1996.

Conclusion

At present no likely enemy could integrate and use technology well enough to compete with American forces, but what about the future? The Gulf War represented a major breakpoint between maneuver and knowledge warfare, and it is safe to assume most potential opponents studied the results closely to determine U.S. vulnerabilities and methods. Both technology and information, like the jungle, are entirely neutral. The newest technologies are available to those who can afford them. Today, many militaries possess individual state of the art capabilities while others are in the process of acquiring highly sophisticated systems at an alarming rate. While these trends are not direct challenges to U.S. military superiority, it remains in our national interest to leverage our technological lead further.

"Achieving dominant battle cycle time capability is one that will require, in addition to the battlefield intelligence systems, rapid planning tools. . . ."[21] What is required for tomorrow is a modification of earlier decision making theory. This suggests a change in the schema our service schools employ to train decision makers. What is required is the teaching of a schema that penetrates the enemy OODA Loop rapidly and dislocates the enemy totally. Such a decision making process will enable U.S. CINCs to deal effectively with all potential adversaries in the mid- to high-intensity arena.

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[21]. Sheila Foote, "Pentagon Acquisition Chief Ups Emphasis on BMC3I," Defense Daily, 11 December, 1995, 339.

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